AMENDMENTS TO THE CLAIMS

Claim 1 (Currently Amended): A process for producing a high purity synthetic quartz powder, the process comprising

baking a silica gel powder made by a wet process, or a synthetic quartz powder made from the silica gel powder, under a low pressure atmosphere simultaneously ~~at a pressure~~ within a pressure range of less than 100 Pa and at a baking temperature, T, in a range of $600°C < T < 1400°C$.

Claim 2 (Currently Amended): A process for producing a high purity synthetic quartz powder, the process comprising

baking a silica gel powder, made by a wet process, to form a synthetic quartz powder, where the baking is ~~in air~~ at atmospheric pressure and at a temperature in a range higher than a temperature at which hydroxyl groups are removed from the silica gel powder and lower than a temperature at which the silica gel powder sinters; and

baking the synthetic quartz powder under a low pressure atmosphere simultaneously ~~at a pressure~~ within a pressure range of less than 100 Pa and at a baking temperature, T, in a range of $600°C < T < 1400°C$.

Claim 3 (Currently Amended): The process according to Claim 2, wherein

the ~~air~~ baking at atmospheric pressure is in dry air or an oxidizing atmosphere;

the baking temperature ~~in the air~~ during the baking at atmospheric pressure is in a range from more than 800°C to less than 1400°C; and

the synthetic quartz powder is baked ~~in the air~~ at atmospheric pressure for a baking time of 5 to 70 hours.

Claim 4 (Previously Presented): The process according to Claims 1 or 2, wherein the low pressure atmosphere is at a pressure of less than 50 Pa.

Claim 5 (Original): The process according to Claims 1 or 2, wherein the baking under the low pressure atmosphere is finished when the low pressure atmosphere reaches a preselected pressure.

Claim 6 (Original): The process according to Claim 5, wherein the preselected pressure is less than 5 Pa.

Claims 7-9 (Canceled)

Claim 10 (Previously Presented) The process according to Claims 1 or 2, wherein the baking under the low pressure atmosphere forms a synthetic quartz powder having a carbon content of less than 2 ppm.

Claim 11 (Previously Presented) The process according to Claims 1 or 2, wherein the baking under the low pressure atmosphere forms a synthetic quartz powder having a hydroxyl group content of less than 50 ppm.

SUPPORT FOR THE AMENDMENT

This Amendment amends Claims 1-3. Support for the amendments is found in the specification and claims as originally filed. No new matter would be introduced by entry of these amendments.

Upon entry of these amendments, Claims 1-6 and 10-11 will be pending in this application. Claims 1 and 2 are independent.

REQUEST FOR RECONSIDERATION

Applicants respectfully request entry of the foregoing and reexamination and reconsideration of the application, as amended, in light of the remarks that follow.

Applicants thank the Examiner for the courtesies extended to their representative during the June 2, 2004, personal interview.

As discussed at the personal interview, the present invention provides a process for producing high purity synthetic quartz powder that utilizes a vacuum baking procedure to reduce residual carbon content.

As discussed in the specification at page 8, line 20 to page 9, line 1, raw material powders for forming high purity quartz powder contain (a) carbon inside individual powder particles, (b) carbon adsorbed on the surface of powder particles, and (c) carbon mixed between powder particles. Conventional preliminary baking and air baking processes can remove the (b) carbon adsorbed on the surface of powder particles and (c) carbon mixed between powder particles. However, these conventional processes do not remove sufficient amounts of the (a) carbon inside individual powder particles. As a result, conventional processes have great difficulty in reducing residual carbon contents to less than 5 ppm.

Applicants have discovered that vacuum baking under a low pressure atmosphere simultaneously within a pressure range of less than 100 Pa and at a baking temperature, T, in

a range of 600°C < T < 1400°C removes, in addition to the (b) carbon adsorbed on the surface of powder particles and (c) carbon mixed between powder particles, the (a) carbon inside individual powder particles. As a result, the present invention provides an efficient means for significantly reducing residual carbon contents to less than 2 ppm.

The significant reducing in residual carbon content achieved by the present invention is illustrated in specification at page 15, Table 1, reproduced below.

Table 1

	Example 1				Comparison Example 1			
	A1	A2	A3	A4	B1	B2	B3	B4
Residual Carbon content (Before Treatment: ppm)	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7
Vacuum Baking Maximum Temperature (°C)	1150	1000	750	650	Non Treatment	500	1150	1500
Heating Time (hr)	4	10	18	24	-	24	4	2
Vacuum Degree (Pa)	10	10	10	70	-	70	200	100
Carbon Content (ppm)	0.4	1.00	1.5	1.9	15.7	10.1	8.7	
Quartz Crucible Carbon content (ppm)	0.4	1.00	1.5	1.9	15.7	10.1	8.7	Raw Material Powder was Sintered like a Block.
Rate of Bubble Content (Before Use: %)	0.03	0.06	0.08	0.09	0.27	0.20	0.21	
Rate of Bubble Content (After Use: %)	1.2	3.4	4.4	5.7	19.3	14.3	13.4	
Rate of Single-Crystalizing (%)	77	74	70	68	33	45	46	
Judgement	◎	○	○	○	x	x	x	x

Notes

The column of Quartz Crucible is the value of the inside surface layer formed with the synthetic quartz.
Judgement is that ◎ is Best, ○ is Good, and x is No Good.
Heating Time is the heating time at the maximum temperature.
Rate of Bubble Content is the value of the layer have 0.5 mm thickness from the inside surface of the crucible.
Rate of Single-Crystalizing is weight of single crystal/weight of raw material poly-crystal (%)
Unit of Rate of Bubble content and Rate of Single-crystalizing is %.

Table 1 shows that before vacuum baking Example A1 and Comparison Example B3 both had the same residual carbon content of 15.7 ppm. Both examples were vacuum baked at 1150°C for 4 hours. Comparison Example B3 was vacuum baked at 200 Pa, and had a residual carbon content after vacuum baking of 8.7 ppm. In contrast, Example A1 was vacuum baked at 10 Pa, and had a residual carbon content after vacuum baking of 0.4 ppm (more than 20 times smaller than Comparison Example B3). Table 1 shows that vacuum baking in accordance with the present invention within a pressure range of less than 100 Pa provides a significant reduction in residual carbon content.

Claims 1 and 10-11 are rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,211,733 ("Fukao") alone or in view of U.S. Patent No. 4,680,045 ("Osafune").

Fukao discloses a method for producing purified silica glass powder by calcining, at a temperature from 1000° to 1300°C, silica gel powder fed continuously into an upper portion of a vertical-type moving bed apparatus while a gas is blown through the silica powder moving bed from a lower portion of the moving bed towards the upper portion of the moving bed. Fukao at abstract. Fukao discloses:

> With respect to the calcining pressure, an operation under atmospheric pressure is simple from the view point of the structure of the apparatus. However, a pressurizing operation or a ***pressure reducing operation*** may be conducted. Fukao at column 4, lines 62-66 (emphasis added)

This is Fukao's entire disclosure regarding vacuum processing.

Osafune discloses a method for preparing tubular silica glass in which a sol solution is gelled in a rotating cylindrical container to obtain a tubular gel, the tubular gel is dried, and the dried tubular gel is sintered in a vacuum or under a helium atmosphere to remove pores. Osafune at column 3, lines 55-61; column 9, lines 64-67.

Fukao and Osafune are both silent about the degree of vacuum during heating. The Office Action admits that "Fukao does not teach ... the specific pressure" and that "Osafune

does not disclose the degree of vacuum". Office Action at page 2, lines 21-22; page 3, lines 9-10. All that Fukao and Osafune disclose is a pressure of less than 101325 Pa (= 1 atm).

Fukao requires during Fukao's "pressure reducing operation" that the pressure not be very low because Fukao requires that a gas flow through the silica powder moving bed during the operation to remove moisture and carbon dioxide.

> [I]t is ***essential*** to blow a small amount of gas to flow from a lower portion towards the upper portion during the calcination. Fukao at column 4, lines 18-20 (emphasis added).
>
> [T]he gas has also a function to transport at least the moisture or a gas such as carbon dioxide generated during the calcinations, out of the system. Fukao at column 4, line 40-44.

The constant introduction of gas into Fukao's moving bed apparatus during Fukao's "pressure reducing operation" will prevent a high vacuum (i.e., low pressure) from being achieved.

Given the failure of Fukao and Osafune to disclose any specific vacuum pressure below 101325 Pa, and Fukao's requirement of a gas flow through a silica powder moving bed to remove moisture and carbon dioxide, the cited prior art fails to suggest the limitation of independent Claims 1 and 2 of "baking ... under a low pressure atmosphere simultaneously within a pressure range of less than 100 Pa and at a baking temperature, T, in a range of 600°C < T < 1400°C ". Furthermore, there is no reasonable expectation that the cited prior art would have successfully led the skilled artisan to the vacuum baking features of Claims 1-2.

The rejection over Fukao alone or in view of Osafune is based on improper hindsight reasoning. The Office Action asserts:

> It would have been obvious to reduce the pressure to the greatest extent possible, so as to maximize the effect of the vacuum. Alternatively it would have been obvious to perform routine experimentation to determine the optimal reduction of pressure. Office Action at page 2, lines 23-25.

However, as discussed above, the cited prior art discloses only that pressure can be less than 101325 Pa. Fukao requires a continuous flow of gas that will prevent maximizing vacuum in order to remove moisture and carbon dioxide from particles. Nothing in the cited prior art suggests that this function of the gas flow can be achieved at a pressure of less than 100 Pa. Only Applicants disclose that vacuum baking should be carried out "under a low pressure atmosphere ... within a pressure range of less than 100 Pa", so that carbon can be removed from inside powder particles where it is inaccessible to a gas flowing around the particles. Because the Office Action's rationale for vacuum baking at a pressure of less than 100 Pa runs contrary to the disclosure of the cited prior art, the Office Action's assertion that the cited prior art suggests the limitation of independent Claims 1 and 2 of "baking ... under a low pressure atmosphere simultaneously within a pressure range of less than 100 Pa and at a baking temperature, T, in a range of 600°C < T < 1400°C " is based on Applicants' own disclosure. Thus, rejection over Fukao alone or in view of Osafune is based on improper hindsight reasoning.

Because the cited prior art fails to suggest the limitation of independent Claims 1 and 2 of "baking ... under a low pressure atmosphere simultaneously within a pressure range of less than 100 Pa and at a baking temperature, T, in a range of 600°C < T < 1400°C "; there is no reasonable expectation that the cited prior art would have led the skilled artisan to the claimed invention; and the rejection over Fukao alone or in view of Osafune is based on improper hindsight reasoning, the prior art rejection should be withdrawn.

Claim 10 is further patentably distinguishable over the cited prior art. The cited prior art is silent about processing to remove carbon from inside individual powder particles. There is no reasonable expectation that the skilled artisan would have been led by the cited prior art to the Claim 10 limitation of "a synthetic quartz powder having a carbon content of less than 2 ppm". This feature is not inherent (i.e., necessarily present) in the cited prior art at

least because each of the cited prior art is silent about the residual gases present in its vacuum, and vacuum baking in an atmosphere containing carbon (e.g., a hydrocarbon atmosphere) would not create as great a driving force to remove carbon as vacuum baking in, e.g., an inert gas atmosphere and thus would not remove carbon to the same extent.

Claims 5-6 and 3 are objected to under 37 C.F.R. § 1.75(c). In addition, Claims 2-6 and 10-11 are rejected under 35 U.S.C. § 112, second paragraph. To obviate the objection and rejection, Claims 1-3 are amended.

Applicants respectfully request that the Examiner acknowledge receipt of the certified copy of the priority document filed July 30, 2003. A copy of a date-stamped filing receipt is attached.

In view of the foregoing amendment and remarks, Applicants respectfully submit that the application is in condition for allowance. Applicants respectfully request favorable consideration and prompt allowance of the application.

Should the Examiner believe that anything further is necessary in order to place the application in even better condition for allowance, the Examiner is invited to contact Applicants' undersigned attorney at the telephone number listed below.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
Norman F. Oblon

Corwin P. Umbach, Ph.D.
Registration No. 40,211

Attachment:
Copy of a date-stamped filing receipt dated July 30, 2003

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/03)
CPU:smi